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ABSTRACT

Within the Mathematics of Finance classes at the Smeal College of Business Administration at Penn State University, lectures are developed using Asymetric's Toolbook program and are presented through a computer system. This approach was implemented because it has the potential to convey effectively concepts that are ordinarily difficult to communicate to large classes of students. For example, the class can input arbitrary interest rates and instantly see their effects on other variables. In the fall semester of 1992, an analysis was conducted on a class of 58 junior-level actuarial science students by making video recordings of all class lectures. One camera focused on students and their physical reactions and the second camera recorded images projected by the computer system. Students also took pretest and posttest attitude surveys about the lectures. The video-recording technique was an effective methodology, in spite of the time required for analysis. Students, as expected from their pretest attitudes, found the approach comfortable and appeared to perceive the animation of the concepts and ideas as useful and attention gaining. One table and seven figures present analysis data. (Contains 6 references.) (SLD)

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An Analysis of A Computer Assisted Learning System: Student Perception and Reactions

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Abstract: Within Mathematics of Finance classes at the Smeal College of Business Administration at Penn State University, lectures are developed using Asymetric's Toolbook and are presented via a computer system. This approach was implemented because it has the potential to effectively convey concepts that are ordinarily difficult to communicate to large classes of students. For example, the class can input arbitrary interest rates and instantly see their effect on other variables.

In the fall semester of 1992, an analysis was conducted on a class of 58 junior level Actuarial Science students. The methods used to make this analysis were to video record all class lectures with two video cameras. One camera focused on the students and collected their physical reactions such as facial expressions and body movements and the second camera recorded images projected by the computer system. Students also received a pre and post attitude survey to collect their perception of the computer-assisted lectures.

The Smeal College of Business Administration at the Penn State University continues to investigate the potential of computer-assisted learning systems. Within Mathematics of Finance classes, lectures are developed using Asymetric's Toolbook and are presented via a computer system. This approach was implemented because it has the potential to effectively convey concepts that are ordinarily difficult to communicate to large classes of students. For example, arbitrary interest rates can be fed to the system and students can instantly see a visual representation of their effect on other variables. The instructor can ask questions and input student responses and electronically graph the result during lectures to help monitor the classes' attentiveness or understanding of the material. This approach adds additional dynamics to lectures and assignments.

While it seemed, from an instructor perspective, that the computer-assisted learning approach could positively impact classes, it was unclear as to how students would react to it. A pilot study was therefore conducted to collect student perceptions and reactions to this instructional approach. The objectives were to make an initial assessment of the computer-assisted lecture delivery format; to collect student reactions to this delivery format; and to investigate the potential of video recording as a method of data collection because, among other things, videotaping has been used extensively for subject observation with substantial benefits reported (Baum & Gray, 1992).

Methods

In the fall semester of 1992, an analysis was conducted on a class of 58 junior level Actuarial Science students. In previous years, the general characteristics of the classroom were as follows: each student had a copy of the professor's typed notes upon which they wrote comments; the professor knew each student by name; an attempt was made to call upon each student at least once each class to respond to question related material; and an important part of each lecture was explaining concepts to the "man on the street." The change this semester was that lectures were presented via a computer systems using Toolbook.

There were two methods of analysis used. One method was to video record all class lectures. For video recording, the researchers used two cameras. One camera focused on students to collect their physical reactions such as facial expressions and body movements and a second camera recorded the visual images projected by the computer system. The researchers later combined the video signal so that physical reactions could be seen simultaneously with what was projected electronically by the computer. Thirty-two 75 minute class lectures were recorded of which 7 are examined in this paper. For analysis, non-verbal communications as well as classroom interactions were examined relative to the delivery format.

The second method used to assess the impact of this technology was an attitude survey. In week one of class, students were given an introduction to computer-assisted lectures and informed that throughout the course, lectures of this type would be given. At the end of the first week, students received a pre-attitude survey .

A post-attitude survey, identical in nature to the pre-attitude survey, was given in the last week of class. The researchers compared surveys to observe if any differences occurred in attitude toward the computer-assisted lectures from the beginning of the semester to the end.

Each survey presented statements to which respondents rated their reactions on a 9 point scale from 0 to 8. The scale ranged from Strongly Agree (0 points), to Indifferent (4 points), to Strongly Disagree (8 points). Of the 58 students who completed a pre-attitude survey, only 31 completed a post-attitude survey. The analysis of survey data is, therefore, based on 31 respondents.

Results & Discussion

Videotaping method

Video recording class lectures appears to have potential merit in monitoring student reactions to new technological approaches in the classroom. The video medium provided a permanent record of students and how they responded to the computer-assisted lectures. Numerous observations could be made specifically about the technology, as well as the class in general, and these observations could be reviewed repeatedly and verified by others.

Video recording lends itself to the collection of large amounts of various kinds of data, which requires more time, effort, and resources to analyze. The advantages of this technique relative to cost need to be more thoroughly investigated. At present, however, the video recording approach as presented in this study appears to be an effective method for identifying student reactions to computer-assisted lectures.

Videotaping results: classroom interaction

For this analysis, tapes from five class sessions were reviewed. The researchers look at the following classroom interactions:

- areas to which the majority students directed their attention (e.g., professor's typed notes, the professor or the projected image) in response to the computerized lectures;
- areas to which the majority students directed their attention in responses to type of visual images projected (e.g., graphs).

Computerized lectures can, in many cases, take significantly longer to develop than traditional lectures. Because of this time and labor intensiveness, it is important to ensure that the visual information

projected effectively cues students and is useful to them. By making observations, the researcher hoped to improve the presentation material by identifying screens designs which caught student attention and designs to which students responded favorably.

To determine whether or not screen designs effectively cued student attention, the researchers counted each time the majority of students look up or looked down in response to what was projected by the computer. Four categories were created:

1. No visual and looking up
   The number of times the majority of students were looking up when no visual was projected by the computer.

2. No visual and looking down
   The number of times the majority of students were looking down when no visual was projected by the computer.

3. Visual on and looking up
   The number of times the majority of students were looking up when a visual was projected by the computer.

4. Visual on and looking down
   The number of times the majority of students were looking down when a visual was projected by the computer.

If the purpose of presenting visual information via a computer system is to promote, in some way, student understanding, then it becomes important to ensure that the visual effectively conveys its meaning and that students attend to it. The primary reason, therefore, for identifying these categories was to determine, in a general sense, if students viewed the visual information when it was presented. The highest incidences occurred in the visual on and looking down category (see Table 1).

Table 1
Response to Visuals: Attention Areas

	Class 1	Class 2	Class 3	Class 4	Class 5	Total
No visual & looking up	15	0	12	1	3	31
No visual & looking down	10	0	7	13	0	30
Visual on & looking up	9	15	2	19	13	58
Visual on & looking down	16	14	8	22	18	78

This means the there were 78 incidences when the majority of students were looking down for the period of time when the visual was projected. It should be pointed out that students had the professor's typed notes with which to follow the lecture. Thus, it is to be expected that they would page through these notes while the concept was discussed. Oftentimes the professor talked through visuals using the computer mouse to point out key areas and formulas. Frequently during this time, a large portion of the class referred to the

professor's notes and paged back and forth through them. It appeared that, among other things, the notes enabled students to bring together additional information that may or may not have been presented on screen. The reliance on the notes seems to provide an additional means by which students individually verified the presented information and or came to understand it.

Given the value of the projecting visual information for the entire class to view and the way in which students, during class lectures, utilized the professor's typed notes, it is difficult to assess the effectiveness of screen designs. A future inquiry might include a control group which is presented the visual information unaccompanied by the professor's notes to more accurately identify student reactions.

Videotaping results: reactions to visual types

The researchers wanted to identify the types of visuals (text, animated graphs or tables) which most effectively cued student attention. It appeared that students looked down or took notes when visuals containing text and formulas were presented. On most occasions, however, when the professor presented graphs containing animations, students looked up. Two reasons are suggested this observation. First, the professor's typed notes contained formulas and replicated what was present on screen and thus there may have been no need for students to look up. They could easily follow the professor by looking at his typed notes. Second, unlike text and formulas, animated tables and graphs can not be duplicated on paper. Animation may have received more attention because of its distinctiveness. Animation as an attention gaining device can be effective since attention is influenced by unique stimuli. Possibly, animating tables and graphs was unique enough to gain students' attention.

General observations:

Video recording made additional observations about the class possible and some of these observations are presented below.

- For five of the class sessions, the number of student initiated interactions with the professor were recorded. Each time a student commented or asked a question, it was considered an interaction. If a student, for example, asked a question and then followed up immediately with a second question, then it was counted as one interaction. There were 83 occurrences when students initiated interaction with the professor, 32 of which were initiated by males and 51 by females. Such information may prove useful to the professor since classroom interaction among all students was highly encouraged.

- Cueing students with key words is attention getting. Students, as observed in this study, spent much time following along with paper handouts and often ignored what was projected on screen. For example, when the professor said, "I have a picture here." students looked up, and on subsequent occasions the word "picture" appeared to get their attention.

- Much can be gained from observing students and watching their body language and reactions. In some cases an observer can readily tell when students do not understand or are confused (Alessi & Trollip, 1985). Throughout the course the professor constantly challenged students by posing questions. Students often displayed behaviors like smiling or looking downward when they did not know the answer. It was also clear by viewing the video tapes when more than one student was having difficultly with a concept or question. In such cases students looked to one another, shook their head or made a facial expression.

Attitude Survey Results

On a survey, subjects ranked the number of computer courses they had completed on a 10-point scale ranging from 0 to 9 or more completed courses. Completed computer courses was used as a measure of computer knowledge (Rattanapian, 1992). The researchers obtained this measure to determine if knowledge

about computers influenced perceptions of the lectures. On average, students completed 2 computer courses. Figure 1 shows the percentages of respondents by number of courses completed.

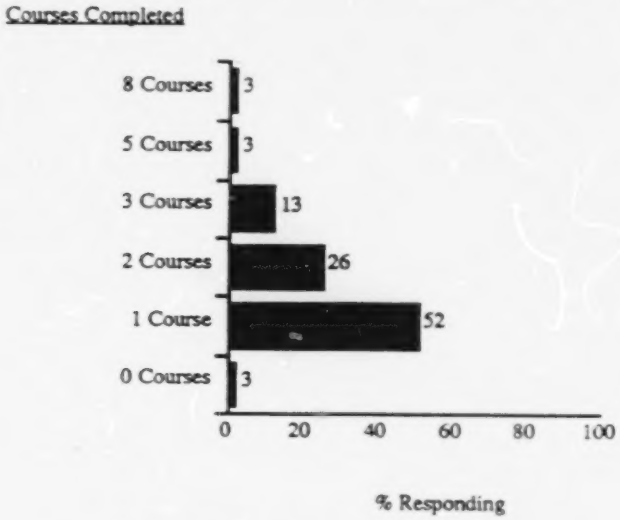

Figure 1. *Computer Courses Completed*

Given the proliferation of technology in today's classrooms and the use of computers to present information electronically, the researchers sought to identify the extent to which students in this class had been exposed to computerized lectures. On the pre-survey, students ranked their experience and on average reported having no experiences with the lecture format. (see figure 2).

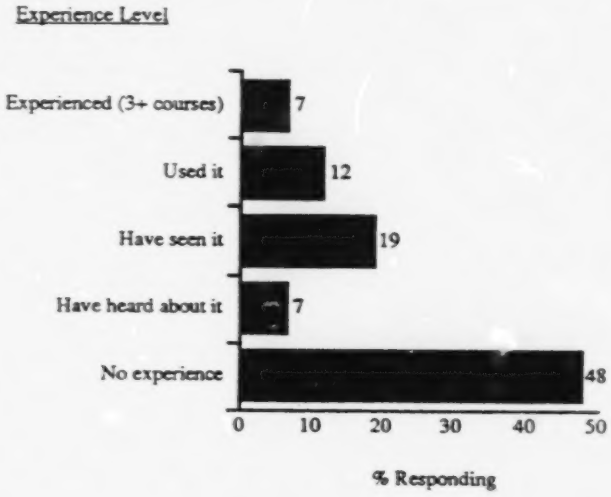

Figure 2. *Experience with Computer-Assisted Lectures*

Despite the lack of exposure, students anticipated that the computer would not make lectures more complex (see figure 3). On the survey, for example, students were asked if they thought the computerized lectures would be easy to follow. Responses to this item were positive and this perception remained constant from the pre to the post survey.

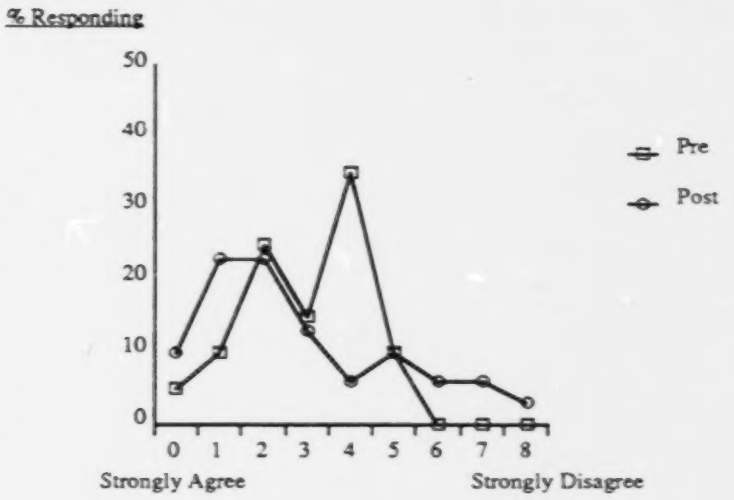

Figure 3. *Lectures were easy to follow pre and post surveys*

Students anticipated that the lectures would be informative (see figure 4). On the survey, students were presented the following item, "Computer-assisted lectures will be informative." Responses tended to be on the positive side and this perception remained constant throughout the semester.

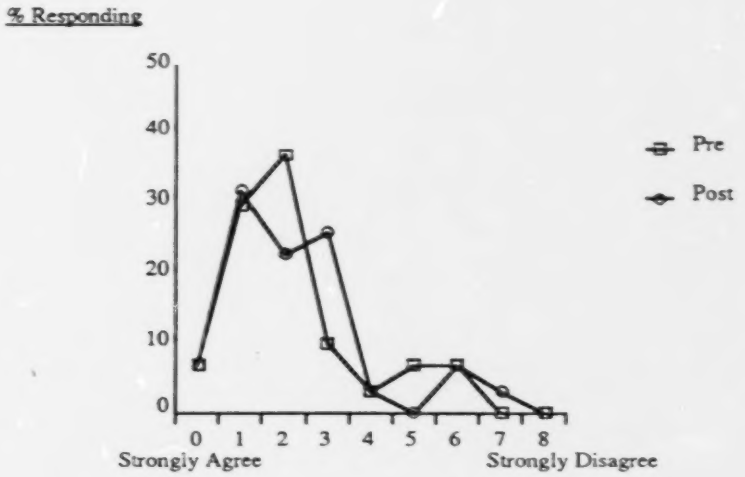

Figure 4. *Lectures were informative pre and post surveys*

Computer familiarity and attitude

Classroom computers are neutral in design but lack neutrality often times in the way they are used (Jones, 1987) and perceived. Males, for example, have been found to readily express interest in computers while females are less likely to do so (Miura, 1987). Students in this study had varying levels of computer

expertise ranging from novice to experienced users. The researchers were interested in determining if computer familiarity effected (positively or negatively) students' attitude toward lectures. As a measure of familiarity, number of computer courses completed was used based on the assumption that some familiarity with computers is required with course completed. Familiarity did not appear to negatively bias students' opinion of lectures and in fact, students appeared to look forward to the teaching format.

At the beginning of the semester, in the pre-attitude survey, students were asked if they thought the lectures would dramatically impact the way in which the course was taught. Responses, examined in terms of computer familiarity, show that for some respondents the perceived degree of impact of the computerized lectures decreased as the number of computer courses completed increased (see figure 5). Thus, those having completed more computer courses felt that the computerized lectures would have less of an impact than those with fewer courses. This may suggest that those with more courses completed understand the technology and its limitations to a greater extent than those with fewer courses. It should be pointed out, however, that only 7 students completed more than 3 courses and the majority of respondents completed fewer than 2 courses. From such a small sample, it is difficult to assess whether or not this trend would persist for larger populations.

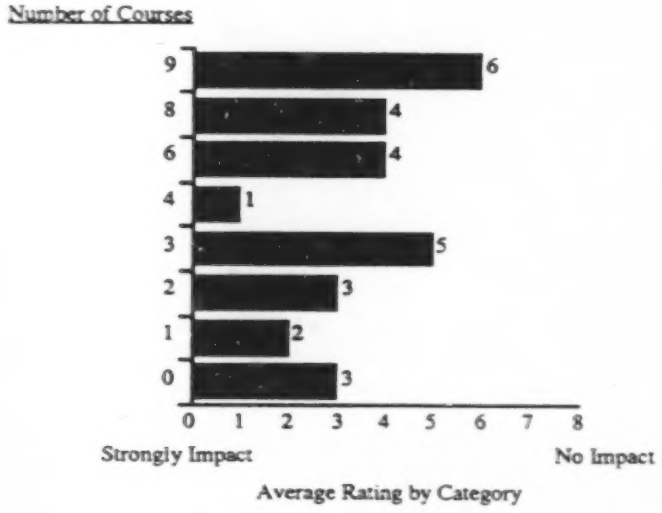

Figure 5. *Perceived Impact by Number of Computer Courses*

On the pre-attitude survey, students indicated whether or not they would feel comfortable being taught with computerized lectures. For this analysis, there were 15 out of the 32 respondents who had completed fewer than 3 computer courses and they indicated that they would feel comfortable being taught with computerized lectures (see figure 6). Of these 15 respondents, fewer computer courses completed coincided with favorable ratings. There appeared to be a tendency for those who had completed fewer courses to indicate that they would feel comfortable being taught with computerized lectures. Again, because of the lack of distribution of students across the different levels of courses completed, it should not be concluded that those with more familiarity would feel uncomfortable being taught with computerized lectures. On the post-survey, attitudes toward being comfortable with computerized lectures seemed to even out.

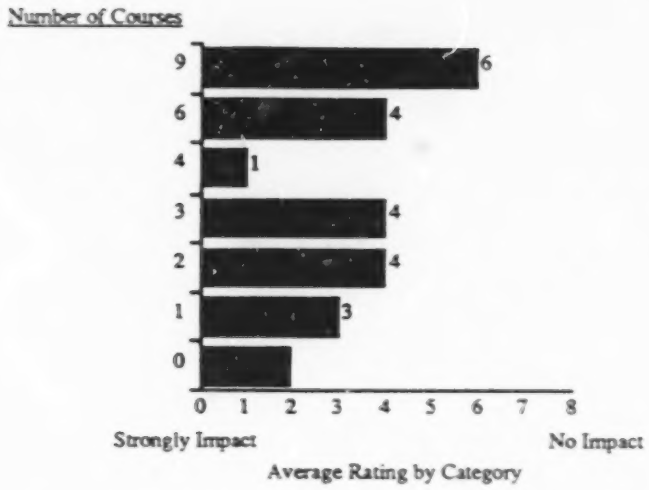

Figure 6. *Comfort by Computer Courses completed: pre survey*

Animations and attitude

Many of the lectures included animations of tables and graphs to visually represent concepts and ideas. The professor could, for example, when discussing interest rates, ask students to suggest an appropriate rate of interest. The given rate could be input into the computer and by animating the graph or table effects on other variables could be instantly represented. Students perceived the animation of concepts positively both prior to their exposure to animation and after long-term exposure to it. From the data collected students anticipated at the beginning of the semester that animations of graphs would be attention getting and useful (see figure 7). This perception remained constant, for the most part, from the beginning of the semester to the end.

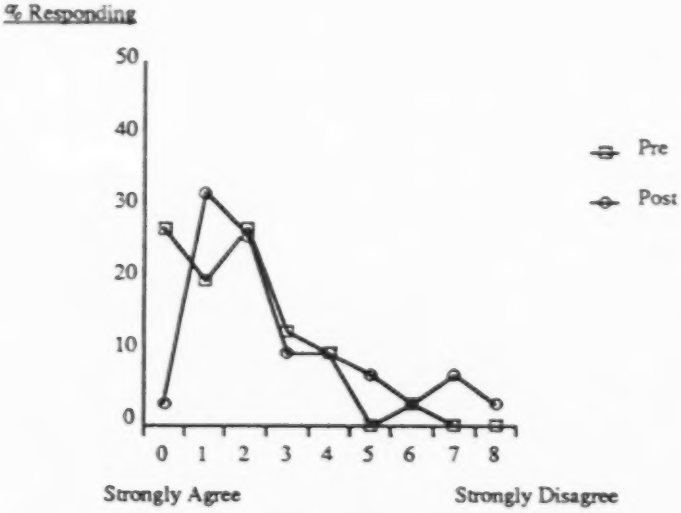

Figure 7. *Animating Graphs: pre and post survey*

Summary

This pilot study attempted to make an initial assessment of student reactions to computer-assisted lectures and thus no efforts was made to control for extraneous factors which may have influenced student attitudes during the course of the semester. Given the constraints of this study, the researchers hesitate to make any generalizable conclusions, however, some interesting observations were made. First, video recording class lectures with two video cameras is an effective technique to assess the implementation of a new classroom technology. Video preserves rich details about observations which can be studied repeatedly and validated by other researchers (Van Dalen, 1979). One drawback to this technique is that video recording lends itself to the collection of large amounts of data and consequently requires substantial resources in time, money and energy to make thorough analyses. Second, upon review of the video recordings it appeared that students tended not to look at visuals which included text or formulas and appeared more attentive to animated tables and graphs. This was expected because students had the professor's typed notes with which to follow the lectures. Third, the subject population had very little computer knowledge or exposure to computer-assisted lectures. Results, however, from the pre-survey show that students anticipated that the lectures would be easy to follow and informative and that they would feel comfortable being taught with this delivery format. The researchers were concerned that students, without much computer familiarity, might be skeptical about the delivery format which may impact learning. Fourth, students appeared to perceive animation of concepts and ideas as useful and attention gaining. Moreover, its use in this study whereby the professor maintained an interactive dialogue with students and fed their responses into the computer and animated results, from the researchers' perspective, added additional dynamics to class lectures and assignments. This technique also helped to monitor student attentiveness in a large lecture room.

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